Introduction

The first *Puget Sound Update* was published in 1990. Then, the Puget Sound Ambient Monitoring Program, or PSAMP, was only two years old and scientists had been collecting information for its initial component studies for about a year. Ten years later, PSAMP scientists continue to collect and evaluate data that make it possible to assess the health of Puget Sound and to prepare the *Puget Sound Update* and other more detailed technical documents.

Even a quick glance around the Sound provides evidence of changes in our environment since the first *Puget Sound Update* was written. New developments along the shore have changed Puget Sound beaches. Many types of fish, including wild chinook salmon, Pacific herring and rockfish, are less abundant in the Sound. Bluffs have eroded onto beaches, sometimes endangering people or their homes. Bigger ships visit our ports. Perhaps most noticeable, many more people live in the Puget Sound region. In fact, there's almost one chance in six that a reader of this report didn't live in the basin when the first *Puget Sound Update* was produced in 1990.

This report, like previous versions of the *Puget Sound Update,* attempts to answer the questions of citizens, lawmakers, resource managers and scientists about the condition of Puget Sound's waters and its biological resources. The goal of the *Puget Sound Update* is to provide information that can help readers evaluate current efforts to protect and restore Puget Sound's water quality and to point out water quality and resource management issues that might require attention now and into the future.

Figure 2. Puget Sound and Georgia basins.

The Puget Sound Ambient Monitoring Program

The PSAMP is a long-term effort to investigate environmental trends, improve decision-making and prevent overlaps and duplication in monitoring efforts. Under the authority of the Puget Sound Water Quality Action Team and the *Puget Sound Water Quality Management Plan,* two committees direct and oversee the design and implementation of the PSAMP. These committees are composed of scientists and managers from government agencies that help implement the program. Government agencies that monitor portions of the Puget Sound ecosystem as part of the PSAMP include:

- **Washington State Department of Ecology** (sediment, marine water and fresh water)
- **Washington State Department of Fish and Wildlife** (fish contaminants, fish abundance and marine birds and mammals)
- **Washington State Department of Health** (shellfish)
- **Washington State Department of Natural Resources** (nearshore habitat)
- **U.S. Environmental Protection Agency**
- **U.S. Fish and Wildlife Service** (bird contaminants)
- **National Marine Fisheries Service** (fish health)
- **King County Department of Natural Resources** (marine water, sediment and shellfish)

The Puget Sound Water Quality Action Team support staff coordinates the PSAMP activities of these agencies.

Scope of this Document

Ideally, the *Puget Sound Update* would report on the condition of the aquatic ecosystems in the entire Puget Sound/Georgia Basin region shown in Figure 1. This region is bounded on the east by the crest of the Cascade mountains from south of Mt. Rainier into Canada and on the west by the mountains of Vancouver Island and the Olympic Peninsula. The centerpiece of this area is the inland sea of the straits of Georgia and Juan de Fuca and Puget Sound and its many smaller waterways.

In reality, this report focuses only on conditions in the inland marine waters of Washington State. Complementary studies and programs provide greater detail on the freshwater and Canadian portions of the basin. Although the marine waters of Washington and British Columbia mix freely, the international border between Washington State and British Columbia creates an institutional barrier, making it challenging to develop and share information or coordinate management programs concerning the broader ecosystem. Puget Sound scientists have participated in transboundary efforts to coordinate monitoring and to develop joint environmental indicators for the Puget Sound/Georgia Basin, but the data are not yet available to fully represent the Canadian portion of the system in this report. Where possible, information from the Canadian portion of the ecosystem will be included in future editions of the *Update.*

Upcoming products that will provide information about the rivers, streams and watersheds of the Puget Sound basin include the following:

- Reports and other products of the Salmon and Steelhead Habitat Inventory and Assessment Project (SSHIAP) from the Northwest Indian Fisheries Commission. SSHIAP compiles and analyzes information on river and stream habitat throughout most of western Washington.
- The "State of the Salmon" report (due to be completed by the end of 2000) from the Washington State Salmon Recovery Office. This report will include information on the condition of freshwater systems in the Puget Sound basin.
- King County's Sammamish and Washington Analysis and Modeling Project, which compiles and analyzes information on lake, river and stream water quality and habitat throughout the Cedar-Sammamish basin.
- Data sets, model output, reports and visualization interfaces from the University of Washington's Puget Sound Regional Synthesis Model (PRISM), which incorporates the hydrology of the Puget Sound basin in a spatially and temporally dynamic integrated model.

More complete information about conditions in and around the Georgia Basin is available from a number of publications, including:

- "Environmental Trends in British Columbia 1998," a report of the province's Ministry of Environment Lands and Parks (1998); and
- "Review of the Marine Environment and Biota of the Strait of Georgia, Juan de Fuca Strait and Puget Sound: Proceedings of the British Columbia/Washington Symposium on the Marine Environment, January 13 and 14, 1994" (Wilson et al. (Editors), 1994)

Protecting and Restoring Puget Sound

People place great value and, paradoxically, stress on Puget Sound. Results of environmental research and monitoring have pointed out the effects that humans have on the Puget Sound environment (see, for example, prior versions of the *Puget Sound Update*). Recognizing the potential for environmental degradation and the depletion of natural resources, our society has instituted a variety of programs to protect and restore our environment. Many programs to protect and restore Puget Sound are described in the *Puget Sound Water Quality Management Plan.* Activities and funding to implement this plan are described in the biennial Puget Sound Water Quality Work Plan.

The PSAMP and this Update are organized around five monitoring topics (see sidebar) that relate to human activities and management programs. Each of the next five chapters of the Update addresses one monitoring topic, beginning with a summary of the issues addressed by the topic and followed by a presentation and discussion of recent findings from PSAMP and other studies. PSAMP technical reports and monitoring data are available from the agencies implementing the various monitoring studies. Contact information is provided on pages 125 to 127.

PSAMP's monitoring topics and integrated questions

The PSAMP organizes its monitoring and reporting by topics that relate to specific ecosystem characteristics or human-influenced stresses on the environment:

Physical Environment: Are the physical environments of Puget Sound changing and, if so, how do these changes affect Puget Sound's biological resources?

Pathogens and Nutrients: What are the status and trends of pathogen and nutrient contamination in Puget Sound? How do they affect the Sound's biological resources?

Toxic Contamination: What are the status and trends of toxic contamination in Puget Sound? How does toxic contamination affect the Sound's biological resources and the humans who consume them?

Human Health: What are the risks to human health from consuming seafood from Puget Sound?

Biological Resources: What are the status and trends of Puget Sound's biological resources?

Toward a comprehensive monitoring program

The ambient monitoring accomplished by the PSAMP is only one aspect of a comprehensive system of scientific study of Puget Sound. PSAMP findings often indicate the need for further investigation in the form of ecosystem research or detailed site investigations.

Action Team agencies rely on the research expertise and facilities of many other entities, especially the National Oceanic and Atmospheric Administration, the research office of the U.S. Environmental Protection Agency, the University of Washington and other colleges and universities located throughout the region.

In addition, resource managers are likely to need additional monitoring and assessment to help evaluate the effectiveness of specific programs or projects. Ambient monitoring is a critical element of the scientific study of Puget Sound, but it cannot be truly effective until it is complemented by research, detailed site investigations and monitoring of program effectiveness.

Monitoring and research results, as presented in this *Puget Sound Update*, help regulatory agencies and the Puget Sound community understand how our ecosystem functions and how it responds to human activities and management programs. Through presentation of its findings, the PSAMP can raise awareness of problems and issues affecting Puget Sound. In some cases, monitoring results from PSAMP and other studies will indicate the need for additional scientific investigation. In other cases, monitoring results may directly indicate the need for new policies, amended strategies or specific measures to protect and restore Puget Sound resources. Each of the remaining chapters of this *Update* concludes with a short list of recommendations for acting on the findings presented in the chapter.